Ser. 10/611,882

9580-EP 5134

D4

PCT

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H02K 15/03, 1/27 — A1

(11) International Publication Number: WO 99/12248

(43) International Publication Date: 11 March 1999 (11.03.99)

(21) International Application Number: PCT/BR98/00066

(22) International Filing Date: 28 August 1998 (28.08.98)

(30) Priority Data:
PI 9702802-9 28 August 1997 (28.08.97) BR

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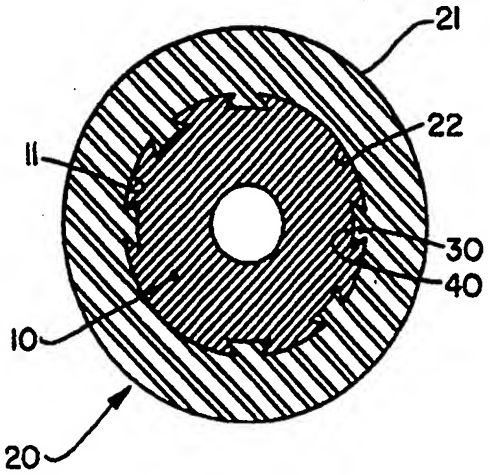
(81) Designated States: CN, JP, SG, SK, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: AN ELECTRIC MOTOR ROTOR

(57) Abstract

An electric motor rotor, including a core (10) and a cover (20), which is molded in a single piece around the core (10) and which incorporates magnet elements, said rotor comprising a plurality of radial projections (30), which are provided in at least one of the parts defined by the cover (20) and the core (10) and which extend towards the other of said parts; a plurality of radial receiving recesses (40), which are provided in the other of said parts and which radially fit and retain respective radial projections (30), in order to avoid relative radial displacements between said cover (20) and said core (10), each radial projection (30) and each receiving recess (40) occupying at least part of the longitudinal extension of the respective part where they are provided and being circumferentially distributed around the core (10), in order to compensate the action of the centrifugal force over the cover (20) during the operation of the rotor.



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XXCID: <WO___9912248A1_I_>

AN ELECTRIC MOTOR ROTOR

Field of the Invention

The present invention refers to an electric motor rotor of the type used in a hermetic compressor for refrigeration systems and, more specifically, to an assembly arrangement for the cover and core of the electric motor rotor.

Background of the Invention

The electric motor rotor with permanent magnets comprises magnets, which are concentrically mounted to the rotor core and around the motor shaft, and a cover, which is provided externally to said magnets, in order to retain them close to said core, avoiding relative radial and circumferencial displacements between said core and said magnets during the operation of the motor, when the magnets are submitted to centrifugal forces, which tend to separate them from the core, and to shearing forces, which cause the circumferential displacement of said magnets around the core.

Besides having the function of maintaining the magnets close to the core, the cover also avoids the disaggregation and release of magnet fragments caused by the forces existing thereon, as mentioned above.

In one of the cover constructions discussed in copending Patent Application PI9601756, the cover incorporates magnet elements in the form of a particulate magnet material, preferably magnet powder included in a mass of an adhesive material, which defines the cover and which will be injected, for example around a mold inside which is found the rotor core. In this construction, the cover is mounted around the rotor core, in order to avoid the occurrence of relative circumferential or axial

movements between said cover and said core.

Although overcoming the deficiencies of the known covers discussed in said copending Patent Application, in situations in which the rotor operates in high rotation, combined with other severe operational conditions, the injected cover incorporating magnet elements, depending on its constructive limitations, is fragile and may break by action of the centrifugal force thereon.

This situation is worsened when the material which forms the magnet elements is noble, such as neodymium, ferro-boron, samarium-cobalt, or more modern alloys with noble materials, since in this cases the cover is constructed with reduced thickness, which makes it more fragile.

The thickness reduction of the rotor cover can be achieved in function of the best relative remanence (Br) and coercitivity (Hc) between the magnet elements formed with noble material and those with usual magnetic material. The same rotor efficiency may be achieved with a cover incorporating magnet elements obtained from noble materials and with a reduced thickness in relation to the thickness of the covers incorporating a conventional magnetic material.

Disclosure of the Invention

Thus, it is an objective of the present invention to provide an electric motor rotor with a cover which incorporates magnet elements and which, besides retaining said magnets close to the core for a longer operational life time and being industrially viable, maintains its integrity, even when submitted to the intense action of the centrifugal force resulting from the rotor operating in a high rotation and to other severe operational conditions, such as temperature, chemical environment, start and stop regimen, etc..

This and other objectives are achieved by an electric motor rotor including a core and a cover, which is molded in a single piece around the core and which incorporates magnet elements, said rotor comprising a plurality of radial projections, which are provided in at least one of the parts defined by the cover and the core and which extend towards the other of said parts; a plurality of radial receiving recesses, which are provided in the other of said parts and which radially fit and retain respective radial projections, in order to avoid relative radial displacements between said cover and said core, each radial projection and each receiving recess occupying at least part of the longitudinal extension of the respective part where they are provided and being circumferentially distributed around the core, in order to compensate the action of the centrifugal force over the cover during the operation of the rotor.

Brief Descriptin of the Drawings

The invention will be described below, with reference to the attached drawing, in which:

Figure 1 shows, schematically and in a sectional view, a cover incorporating magnet elements and provided with locking elements for radially locking said cover and the core of the rotor, according to the present invention; and

Figure 2 shows, schematically and in a longitudinal view, the cover illustrated in figure 1.

Best Mode of Carrying Out the Invention

The present invention refers to an electric motor rotor, of the type having a core 10, which will be affixed involving at least part of a rotor shaft (not illustrated) and around which is mounted, against an external lateral surface 11 of said core 10, a cover 20 incorporating magnet elements.

The rotor covers of the present invention are obtained by molding (injection or casting), incorporating or being defined by magnet elements when the latter are cast around the rotor core. In this last case, the cover is obtained by casting magnetic material directly around the core or in a mold, thus obtaining a magnetic ring which will be later affixed around the rotor core.

The production of the rotor cover by injection may be achieved also directly around the rotor core or previously in a mold, said cover being posteriorly affixed to the rotor core by an appropriate technique.

In this solution, the cover 20 incorporates magnet elements in the form of a particulate magnetic material, preferable magnet powder included in a mass of an adhesive material, which defines the cover and which will be injected, for example, around a mold inside which is found the rotor core. In this construction, the cover may be obtained from ferrite or rare earths, said magnet elements being bonded by an adhesive material for molding the cover.

In any of the manners of obtaining the cover including magnet elements, the attachment of the latter around the rotor core should be provided with a radial, axial and circumferential locking in relation to said core.

According to the present invention, the cover 20 is provided concentrically to the core 10, so as to involve at least laterally said core and the faces of the magnet elements, other than those faces seated onto said core 10, said cover 20 having a cylindrical external lateral surface 21 and an internal lateral surface 22 confronting with the external lateral surface 11 of the core 10 and with a shape mating with the shape of the portion of the core 10 to be involved by said cover 20.

The cover 20 of the present invention may have, for example, a pair of end flanges, not illustrated, each being seated against at least one portion of a respective end face of a pair of end faces of the core 10 and extending up to the region of the rotor shaft, so as to provide a relative axial locking between the cover and the core. The cover 20 may have end flanges with any extension, ranging from zero up to the value of maximum extension, as illustrated.

According to the present invention, the electric motor rotor comprises a plurality of radial projections 30, provided in at least one of the parts defined by the internal lateral surface 22 of the cover 20 and external lateral surface 11 of the core 10, projecting towards the other of said parts, and a plurality of receiving recesses 40, which are provided in the other of said parts and which radially receive and retain the radial projections 30, in order to avoid relative radial displacements between the cover 20 and core 10 of the rotor. As a function of the construction of said radial projections 30 and receiving recesses 40, the fitting of said parts further provides a relative circumferential locking between the cover 20 and core 10 of the rotor.

The radial projections 30 and the receiving recesses 40 are circumferentially distributed, from the confronting lateral surface of the part where they are provided, in order to balance the centrifugal force acting between the cover 20 and core 10 parts, upon the operation of the rotor, mainly under high rotation operational conditions. In the illustrated solution, the radial projections 30 and respective receiving recesses 40 are symmetrically and circumferentially distributed in the respective part, according to an orthogonal plane in relation to the rotor. In a

variant of this construction, the distribution of radial projections 30 and respective receiving recesses 40 are angularly and equally distributed around the rotor shaft at the respective part when, for example, the confronting surfaces of said parts have a circumferential contour. In another variant of this construction, each said orthogonal plane has an alignment of radial projections 30 and receiving recesses 40.

In order to obtain the radial locking, object of the present invention, between the cover 20 and the core 10 of the rotor, at least part of the radial projections 30 and of the receiving recesses 40 occupies at least part of the longitudinal extension of the part where these parts are provided.

In a constructive option of the present invention, each receiving recess 40 is defined so as to receive and retain, longitudinally, at least one radial projection 30. In the illustrated solution, each radial projection 30 is retained in a respective receiving recess 40, each radial projection-receiving recess assembly occupying the whole longitudinal extension of the respective part of cover 20 and core 10.

According to the present invention, each radial projection 30 is in the form of a male locking element acting in a female locking element, which defines a respective receiving recess 40. In the illustrated construction, said male and female locking elements have a dove tail profile and are defined so that each respective axis be orthogonal to the axis of the core 10 of the rotor. Due to this construction, said male and female locking elements further result in a relative circumferential locking between the cover 20 and core 10.

The determination of the shape and dimensions of the radial projections 30 and receiving recesses 40 is a function of the rotor dimensions, number of motor poles, flux lines in the rotor, distribution and higher intensity of the centrifugal force acting over the cover, and characteristics of the manufacturing process of the rotor (difficulty, costs, etc.).

The male and female locking elements, besides providing a radial and circumferential locking between the cover 20 and core 10 of the rotor, they provide said cover 20 with more structural resistance, by increasing its average thickness and defining a structural shape in the form of a cage.

Other possible constructions for the present invention are the provision of radial projections 30 and receiving recesses 40 parallel to each other and helically developed along the respective part, and the provision of radial projections 30 and receiving recesses 40, which are circumferentially and angularly spaced from each other along each longitudinal alignment of the respective part.

CLAIMS

1. An electric motor rotor, including a core (10) and a cover (20), which is molded in a single piece around the core (10) and which incorporates magnet elements, characterized in that it comprises a plurality of radial projections (30), which are provided in at least one of the parts defined by the cover (20) and the core (10) and which extend towards the other of said parts; a plurality of radial receiving recesses (40), which are provided in the other of said parts and which radially fit and retain respective radial projections (30), in order to avoid relative radial displacements between said cover (20) and said core (10), each radial projection (30) and each receiving recess (40) occupying at least part of the longitudinal extension of the respective part where they are provided and being circumferentially distributed around the core (10), in order to compensate the action of the centrifugal force over the cover (20) during the operation of the rotor.

2. An electric motor rotor, as in claim 1, characterized in that the radial projections (30) and respective receiving recesses (40) are distributed around the core (10) of the rotor equally and angularly spaced from each other.

3. An electric motor rotor, as in claim 2, characterized in that each receiving recess (40) fits at least one radial projection (30).

4. An electric motor rotor, as in claim 3, characterized in that at least part of the receiving recesses (40) occupies the whole longitudinal extension of the part where said recesses are provided.

5. An electric motor rotor, as in claim 4,

characterized in that the radial projections (30) and receiving recesses (40) have a dove tail profile.

6. An electric motor rotor, as in claim 5, characterized in that radial projections (30) and the receiving recesses (40) develop helically along the respective part where they are provided.

7. An electric motor rotor, as in claim 1, characterized in that the radial projections (30) and the receiving recesses (40) are provided according to longitudinal alignments, circunferentially offset from each other.

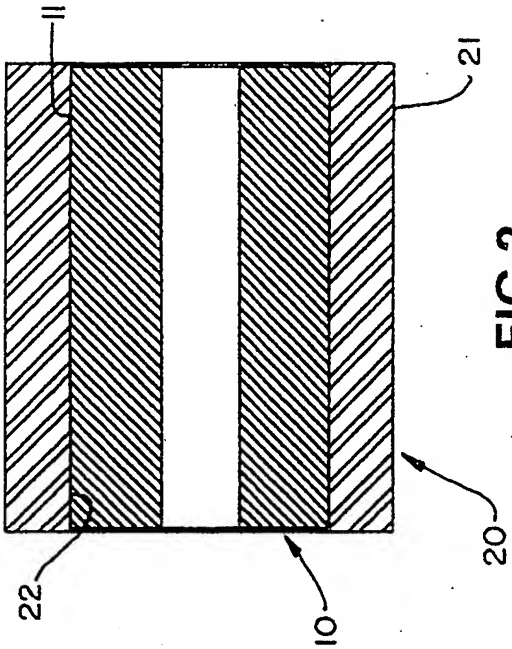

FIG.2

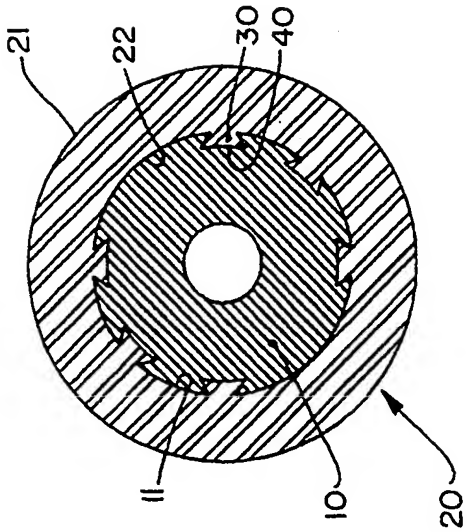

FIG.1

INTERNATIONAL SEARCH REPORT

Inte .onal Application No
PCT/BR 98/00066

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H02K15/03 H02K1/27

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H02K H01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2 089 584 A (OKUMA MACHINERY WORKS) 23 June 1982 see page 1, line 80 - page 2, line 22; figures 3A-5B	1,5
Y	PATENT ABSTRACTS OF JAPAN vol. 9, no. 284 (E-357), 12 November 1985 & JP 60 125149 A (TOSHIBA), 4 July 1985 see abstract	1,5
A	EP 0 569 594 A (FANUC) 18 November 1993 see column 7, line 50 - column 8, line 45; figure 2	5
A	DE 195 31 861 A (DANFOSS) 6 March 1997 see column 2, line 59 - column 3, line 17; figures	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 January 1999	21/01/1999

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int[illegible]ional Application No
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